Ultrasound Guided Peripheral Intravenous Catheter Placement Learning Resource

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Created by: Edmonton Zone Emergency Department CNE Council & RAH ICU NP group; Module developers: Domhnall O'Dochartaigh, Christopher Picard, & Matthew Douma. With thanks for peer review and edits from Peter Godor, Dr Dave Kirschner, Dr Moritz Haager, Dr Warren Ma, Victoria Radford, members of the Edmonton zone ED CNE council. 2022 Pediatric updates Carolyn Elias and Michelle Flynn.

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Background

AHS suggests a limit of four attempts at traditional peripheral vascular access,[1] however there are limited current options at many sites for these patients. Between 10 and 25 percent of patients present to the emergency department (ED) with difficult to cannulate veins.[2,3] In these patients ultrasound guided catheter placement has been shown to decrease the number of intravenous (IV) attempts,[4] decrease time to successful IV placement,[5,6,7] improve patient satisfaction,[8] and in adult patients decrease central line use.[9,10] Nurses have been shown to successfully employ ultrasound-guided peripheral vascular access.[9,11,12] The National Emergency Nursing Association (NENA) recommends the routine use of this procedure by appropriately trained emergency nurses.[13]

Nurses are experts at placing IV's using traditional techniques and this skill is gained over years of practice and is invaluable to patient care. In many cases however we have to 'make do' with a suboptimal placement, either a smaller gauge cannula or a site that is not ideal (e.g. a point of flexion). *Ultrasound is a tool that provides nurses a greater range of vein choices to place the best IV in the best location.*
This resource focuses on the procedural tips and tricks to safely implement ultrasound guided IV placement into routine clinical practice.

Definition

Ultrasound-guided peripheral intravenous catheter (UGIVC) placement is when ultrasound is used to assist a qualified health care provider with IV cannulation from skin puncture through venipuncture, and catheter conformation intra-lumen via direct visualization on an ultrasound machine. UGIVC placement is useful to gain IV access when peripheral IV access is assessed to be difficult with traditional peripheral IV access methods of vein visualization and/or palpation.

Purpose

The purpose of this education package is to describe the process, education, and training required to ensure minimum safe practice with UGIVC placement within those sites whose patient care managers (PCM) approve its use and where a qualified health care provider (HCP) has completed the competency requirements to utilize the skill.

Learning Plan

It is responsibility of all HCPs to self-identify learning needs and undertake appropriate measures to ensure continual competency as determined by their regulatory body and specific work setting. The use of ultrasound by RNs, LPNs and Advanced Care Paramedics is supported by their colleges, as is its use by RRTs under the caveat of direct or indirect physician supervision.

Target Audience: UGIVC procedure is restricted to qualified HCP who demonstrate competency after didactic and clinical education and training.

Insertion of an UGIVC by a qualified HCP can be performed when:

- Skill performance is deemed appropriate by site operational leadership
- The work setting has opportunities to gain and maintain competency in UGIVC insertion

Competency training requires:

1. Complete this training module and its associated learning activities
2. Complete the online self-assessment with a pass mark of 100%. (or 80% via closed book copy)
3. HCP should consult with a CNE to resolve any knowledge deficiencies.

Procedure for attaining UGIVC competency

1. Review the learning package to support knowledge competency.
2. Completion of examination
3. HCP will arrange to attend a training session with a CNE or designate facilitator*. The goal is vein identification/selection and assessment and IV insertion technique on a simulated gel model.
4. Ten successful UGIVC insertions proctored by a mentor** within three months. If not completed within this time period, the health care provider should demonstrate insertion technique on a gel model with a facilitator prior to patient placement.
5. After ten successful proctored placements, the HCP provider may place UGIVC independently.
6. Annual competency revalidation will be required to maintain this competency. (Note: ongoing competence of 12 successful placements a year is required in lieu of annual assessment and recertification and will be self-reported by the qualified HCP)

* this designate is defined as a qualified HCP who has technical competency as well deemed competent at teaching the procedure as assessed by the site CNE.

** A mentor has a minimum number of successful starts to support the learner while also ensuring best patient care. There is no fixed number of successful starts, but a minimum suggested number is 20. Prior to this number there remains significant personal skill development of the mentor. The site CNE/manager will designate who can mentor others in this skill, as other non-clinical factors can play a part in this decision (e.g. interpersonal communication). See role of mentor below for further information

Note: Prior to gaining ten mentored starts a patient might present who is a difficult traditional IV start and no qualified staff are present to utilize ultrasound to gain access. In these cases, ultrasound examination of the patients veins to assess for ease of cannulation and consultation with the patients physician is warranted to decide whether to utilize ultrasound or not. (i.e. in some cases best patient care would be for the staff member to utilize ultrasound rather than blind poking via traditional technique. In these cases, debrief the procedure afterwards with mentor)

Objectives

i. Knowledge

Upon completion of this learning package the HCP will be able to:

1. Discuss the infection prevention and control practices (i.e. PPE, hand washing, probe and site cleaning) when performing UGIVC.
2. Identify the indications and contradictions for UGIVC.
3. Describe the anatomy, physiology, and landmarks of commonly used veins.
4. Describe the principles of the ultrasound technology including ultrasound probe (referred to as 'probe' in this document) selection.
5. Identify the possible complications related to UGIVC.
6. Describe the aftercare of the intravenous catheter including securing/stabilization of the device.
7. Identify the role of the nurse with ultrasound training in supporting other staff gaining traditional IV placement experience

ii. Skill

Demonstrates the following skills:

1. Prepare the probe, equipment, environment, and patient.
2. Select the appropriate insertion site and catheter size and length.
3. Prepare the insertion site.
4. Insert and secure the intravenous catheter that has been placed by ultrasound guidance using aseptic non-touch technique
5. Confirm location of intravenous catheter in the vein.

NOTE: See skills checklist

Clinical Indications

Consider placement of an UGIVC for patients who require IV access to administer medications, IV fluids, and/or blood products that do not require immediate central venous or IO access and who meet one of the following criteria:

1) Patient is known or suspected to be a difficult IV access without visible or palpable peripheral vessels.
2) Does not have an optimal site for IV placement that is easy to cannulate by traditional placement technique (e.g. avoiding an area of flexion, or allowing an optimally sized IV catheter to be placed in larger vein)

i.e. Ultrasound should be considered for a patient whose veins are "not easy or not optimal" to cannulate.

The Provincial Clinical Care Topic Vascular Access Device Infusion Therapy recommends that peripheral IV attempts should be limited to a maximum of four.[1] To best meet this recommendation, patients who are assessed as having moderately difficult to cannulate veins by traditional technique should be considered for early assessment by a HCP with UGIVC competency wherever possible.

NOTE: Practically, if a patient has had four failed attempts at traditional IV placement, the fifth attempt should be made with ultrasound guidance.

A recent study with experienced ED nurses and techs found that in adult patients predicted to be **moderately** difficult prior to IV attempt, the use of U/S improved IV success (71% to >75% respectively) with far more benefit for predicted harder difficulty.[14] In pediatrics a recent RCT found significant time savings (14 minutes vs 28 minutes) improved first pass success (85% vs 45%), and improved dwell time of the IV 7 days vs 2 days with ultrasound use in patients predicted to be difficult access by the DIVA assessment scale (information on next page).[15]

NOTE: UGIVC has a steep learning curve. Upon successful completion of this learning module, providers will have the minimal training and experience to start safely utilizing ultrasonography to assist in IV placement. Local QI registry data found practitioners with 10 to 20 starts achieve around 75% first pass success and higher success with >30 starts. Key to success is to take every opportunity to utilize ultrasound where clinically indicated and your other clinical priorities allow. Procedural time will reduce significantly to less than what it takes utilizing traditional technique on patients with difficult to cannulate veins.

There are two scoring systems that help you better understand the chances of first pass success using traditional IV technique in pediatrics and adults patients respectively.

For pediatric patients: DIVA Scoring Tool[16] predictor of IV difficulty

Predictor	0 Points	1 Points	2 Points	3 points
Visible Vein	Visible	-	Not Visible	
Palpable Vein	Palpable	-	Not palpable	
Age	≥ 36 months	12-35 months		<12 months and/or history of prematurity*

* apply points for a history of premature birth <38 weeks to any applicable patient.

If DIVA 4 or greater predicted first pass success with traditional IV placement is less than 50%, so ultrasound guided IV should be initially considered or an experienced clinician consulted to make an attempt following best practices.[15]

See **appendix A** for suggested ED clinical pathway for pediatric patients

For adults: Modified DIVA to predict difficult access and first pass success.[17]

Each aspect below scores one point and points are totaled up.

- Known history of a difficult IV access
- Expect a failed first attempt or difficult IV access
- Not able to palpate a vein
- Not able to visualize a vein
- Largest vein diameter <3 millimeters

Score	Predicted first pass success with traditional technique
0	98%
1	90%
2	69%
3	55%
4	14%
5	2%

A score of 2 is considered moderate and this predicted first pass success percentage is generally lower than that of ultrasound use.

Videos

These videos demonstrate ultrasound use for vascular imaging and IV placement. They don't completely demonstrate the technique we teach, but will provide good background. (used with permission)

Sterile Placement technique (Note: video comment on use of 1" IV catheter for vessel 0.5cm deep: better practice would be using a 1.75" (4.4cm) catheter, also not demonstrated is assessing tip placement and length of cannula intra-lumen)
https://www.youtube.com/watch?v=aacYrpjF0Kc

Peripheral Venous Access Under Ultrasound Guidance - Part 1 - SonoSite, Inc
https://youtu.be/lREUPXCpK8Y

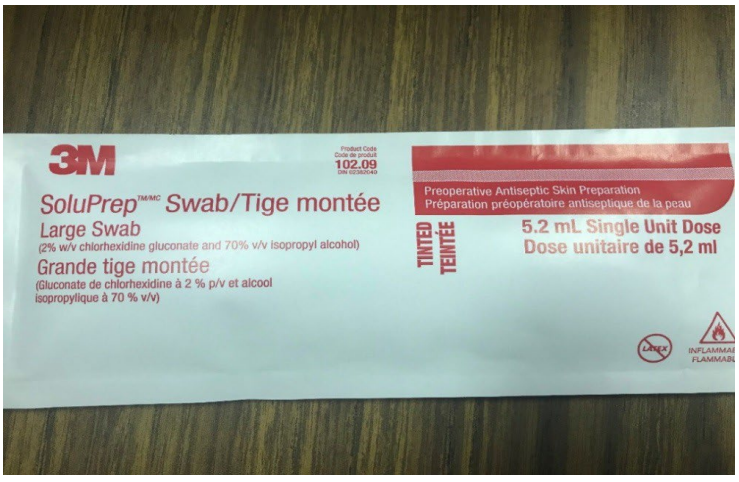
Peripheral Venous Access Under Ultrasound Guidance - Part 2 - SonoSite, Inc
https://www.youtube.com/watch?v=riizCYcXhRU&feature=youtu.be

Ultrasound guided dynamic needle tip positioning in peripheral artery and vein cannulation as well as how to save a posterior wall puncture.
NOTE - no sound on video.
https://www.youtube.com/watch?v=QAJ5rbJua7U&t=3s

Supplies

In addition to the regular supplies for standard IV placement the following is required:

- A longer intravenous catheter (e.g. 4.5cm and 6.4cm)
- Ultrasound gel**
- Sterile Probe cover is required to decrease the risk of infection per Infusion Therapy Standards of Practice [21] A sterile tegaderm can be utilized without effecting the probe
- Gauze or a cloth to wipe away the gel prior to site cleaning
- Chlorohexidine swab sticks work better than the square swaps but both work
- Bedside table to support provider arm bracing



**NOTE: A chlorohexidine swab or chlorohexidine soaked gauze can be used in place of gel. The site is cleaned with the swab and the probe is placed on the still wet solution taking care not to touch the sterilized insertion point. This technique is best utilized by non-novice providers who can place the IV relatively quickly.

Contraindications

- All contraindications of routine IV placement relate to UGIVC such as
- Traumatic injuries/burns to limb
- Presence of arteriovenous fistulas

Complications

All complications associated with traditional IV placement can affect UGIVC (e.g. local infiltration, cellulitis, and thrombophlebitis). Additional complications that apply to ultrasound guided IV placements include the following (mitigating techniques included in **bold**):

- Arterial puncture has been documented to occur approximately 2% of the time when attempting to cannulate veins close to the brachial complex which is similar or slightly less than traditional landmark techniques in this area **(only consider vein cannulation next to an artery (e.g. brachial complex) when sufficient procedural skill with tip tracking has been developed)**
- Larger hematoma formation may be decreased or avoided with the application of **firm pressure for at least 2 minutes** after an unsuccessful cannulation attempt. **(In these cases, pressure should be placed over the site of the vein cannulation and not just the skin puncture site)**
- Risk of extravasation is increased compared to non-ultrasound guided IV placement.[18] **Ensure superficial veins are preferentially chosen and use a longer IV catheter to ensure greater than two thirds of catheter is in the vein: visualized on longitudinal view.**[19]
- Traditionally risk of complication increases as vessel depth increases with vessels deeper than >1.6cm not previously recommended. This was based on studies that utilized 1.88" (4.5cm) long catheters. More recent research found that 100% of catheters failed within 15 hours if <30% of the catheter was in the vein compared to 0% failure for >65% of the catheter in the vein.[19] Infusion standards recommend trying to ensure >2/3 catheters is intra-lumen.[21] **(For all routine adult UGIVC starts use at least 4.4cm long IVs. For veins 0.75cm and deeper, consider longer catheters (e.g. 6.4cm). For accessing deeper veins also utilize a steeper catheter insertion angle (45 degrees) till just before vein cannulation then flatten the catheter angle to facilitate threading)**
- Increased success is seen with larger vessels. Some studies reported a low success if the vessel is <3mm diameter, though in our experience these can be successfully cannulated with a high first pass success by providers with sufficient experience.

- Nerve damage when attempting veins in close proximity to nerve bundle. **(Take time to identify nerves and preferentially avoid veins in proximity to nerves such as the ulnar nerve on the medial aspect of the arm close to the elbow, and radial nerve on the lateral aspect of the wrist. NOTE: If you are close to an artery, assume you are close to a nerve. They will look like a honeycomb in short axis.)**

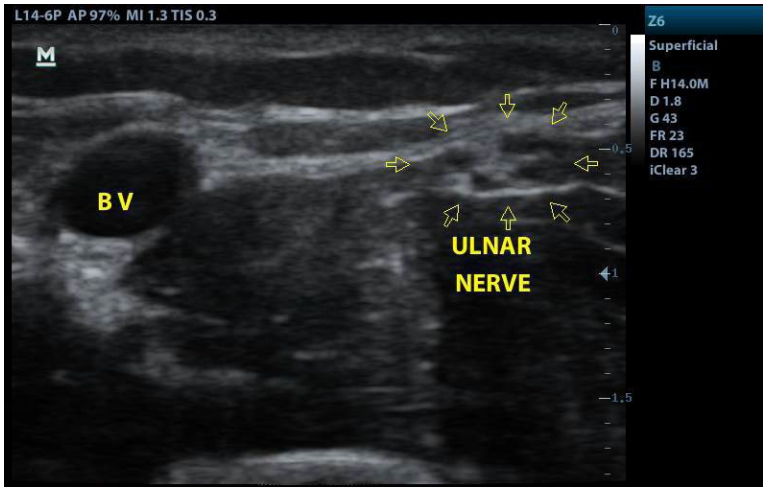


Figure 1 above: Basilic vein (BV) anteriorly and ulnar nerve posteriorly, probe in transverse orientation, proximal to elbow, oriented medially.

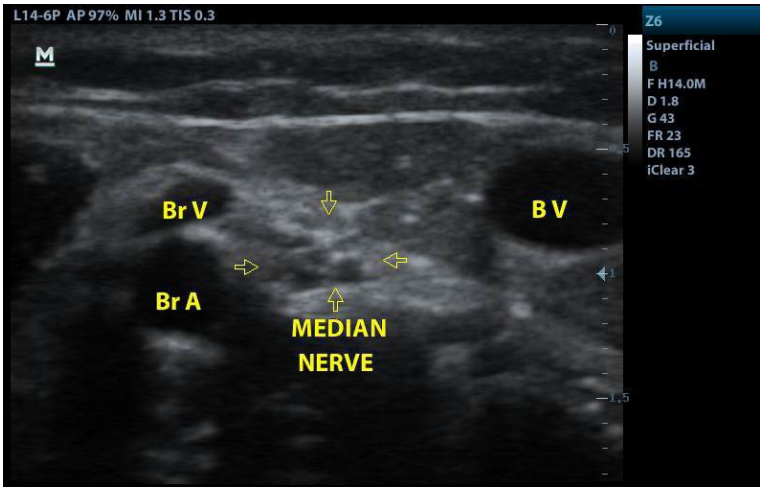
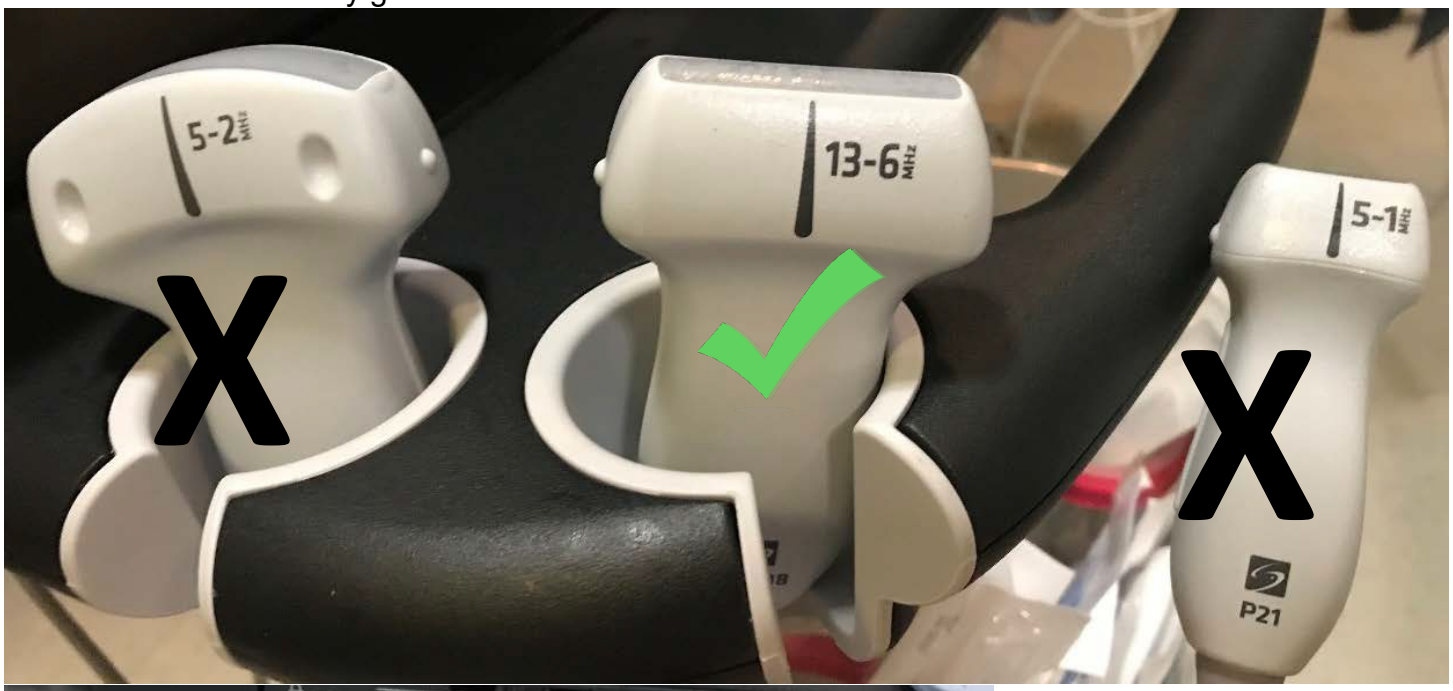


Figure 2. Relationship of Brachial artery (Br A), Brachial vein (Br V), Median nerve, and Basilic vein (B V). Probe is oriented in transverse, proximal to the elbow, marker (M) pointed laterally. Note: there are usually PAIRED brachial veins that run with the brachial artery, but only one of them is visible in this image.

Probe selection

The high-frequency linear array probe should be used to provides higher resolution of the superficial areas of soft tissue. Two examples of high frequency probes are shown below marked by green checks



Clinical Tip

The probe is very fragile and significant care should be taken not to drop it. Either hang the probe in its cradle or hold onto it, don't leave it lying on the bed. Also protect the probe cable from damage, and from being caught in the wheels of the machine.

Vein selection

The same veins of the arms as described in the vascular access clinical care topic can be utilized to cannulate via ultrasound guidance, as are the same veins or areas to avoid.[1] The goal is to cannulate the largest most distal vessel that can be visualized with the least surrounding structures (e.g. artery, nerve bundle). In general order of choice to cannulate (baring any contraindications):

First cannulation choice: forearm veins on both arms such as the cephalic, basilic and median veins. Ideally avoid veins on the lateral aspect of the wrist as the radial nerve runs in close proximity. Also ideally avoid approximately 10cm distal to the antecubital fossa (AC) since cannulating here will result in the catheter tip dwelling in the AC which will might occlude with arm flexion.

Second cannulation choice is the cephalic vein on the lateral aspect of the upper arm. The vessel is generally straight with no associated nerve or artery.

Third cannulation choice: basilic vein on the medial aspect of the upper arm. To avoid the ulnar nerve that is present around the elbow, identify the bifurcation with the median and basilic veins and aim to cannulate just proximal to their join.

Forth cannulation choice is one of the paired brachial veins. Care is required to maintain tip visualization throughout insertion due to the median nerve and brachial artery being in close proximity.

Patient factors and provider positioning can play a role in the above selection of veins.

NOTE: Consider physician consultation for central or midline consideration if all the following three findings are present:

1) If less than three vein options are seen with ultrasound

2) Improvement in veins identified is not expected with treatment (e.g. after fluid bolus in cases of dehydration)

3) Duration of IV therapy is expected to be longer than three days.

Patient factors

Mobile tissue: mobile and soft subcutaneous tissue often found around the brachial and basilic veins can lead to mobile veins that have significant vertical movement with light ultrasound probe pressure. This is commonly seen with geriatric patients. **To assess for mobile tissue, slowly lift the probe off the surface of the skin while assessing for vertical movement of the vein. If there is excessive movement, (e.g. >5mm) then this makes for more challenging placement**.

When cannulating a vein with mobile tissue, when the catheter just enters the lumen if pressure is removed from the probe the vein will pull or drop away from the catheter and the site would blow.

I**t is important to measure/estimate the true depth of the vein when pressure is off the probe to use the appropriate length IV**. Trouble-shooting for placement includes using a second provider to maintain skin tension on the underneath of the arm while keeping clear of the IV placement site. Care to maintain steady probe pressure until the catheter is threaded is also key.

Mobile and calcified vessels: these are sometimes hard to identify until placing the cannula. Sometime a "double ring sign" is noted where a thick vessel wall exists. In older patients there is often less subcutaneous tissue to 'anchor' the vein, and the vein might be calcified. Trouble-shooting placements include using a second provider to maintain skin tension, cannulating just above a bifurcation that might provide some additional vein traction, and using a dynamic vein cannulation technique where the catheter tip is advanced to just above the vein and then the angle of the catheter is lowered and a dynamic forward movement is made like in a traditional placement with the aim of cleanly penetrating the lumen.
KEY: To assist with catheter advancement in these cases continue to track the needle tip a further distance than normal in the vein prior to separating cannula from needle and advancing.

Assessment for thrombus: Veins should be easily fully compressible along their entire length. Thrombus are identified by being unable to compress the vein completely, and in some cases the appearance of thrombus intra-lumen. If a venous clot is identified the physician should be notified so a plan of care can be made for best catheter placement location and consideration of formal ultrasound to confirm the presence of clot and possible anticoagulation. See the following link for a visual example of vein thrombus assessment: Superficial Venous Thrombosis – Core Ultrasound

Pediatric patient placement factors (See pediatric section below)

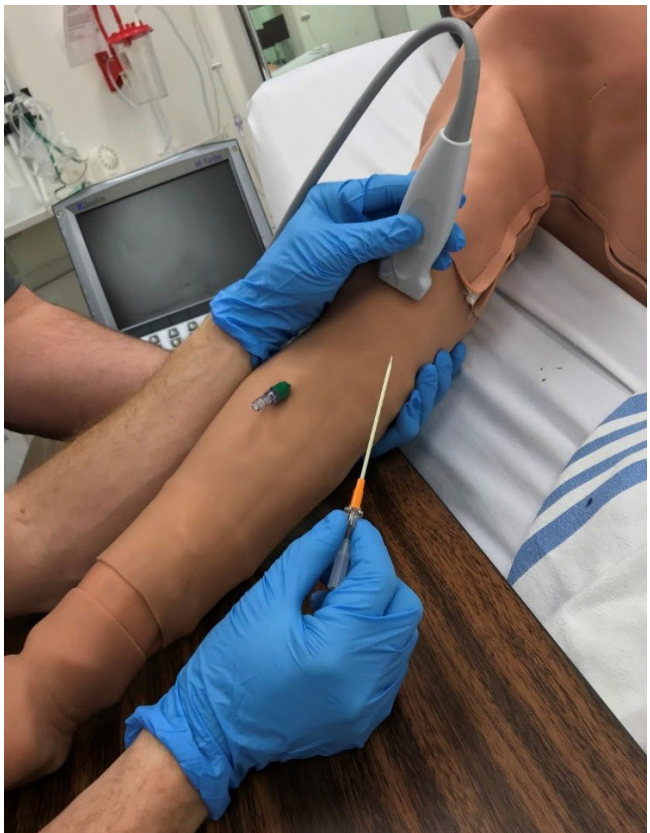
Provider factors

Provider positioning affects how steady and clear an image can be generated, as well as how steadily the catheter can be placed. **After appropriate vein selection this is perhaps the most important step to support successful cannulation**. Ideally, both arms/hands are braced or rested during placement. For the hand holding the ultrasound probe, the 5th and possibly the 4th digits can be used to stabilize the hand again the patient's skin and the forearm to elbow braced. For the dominant hand inserting the catheter, the 4th and 5th digits can again be resting against the patient or other item to stabilize. An area where this is a challenge is when a patient is not able to rotate their arm outward enough and attempting to cannulate veins of the inner (lateral) arm such as basilic and upper brachial veins. **Vein mapping:** ensure the IV (and probe) are lined up on the target vein so that the vein remains in the middle of the screen with catheter advancement.,.

Ultrasound screen position should be in-line with the placement site and the provider's **arms**, **so that they can look directly at the screen and not off to one side. This might result in the best location for the machine to be across the bed.**

Patient and provider positioning

The use of a table and a chair or having the bed at the correct height is key. If required an assistant is useful to help stabilize the arm in cases where patient movement is expected, or if significant mobile soft tissue that needs to be displaced.



Note:

- Table to **brace both probe arm (key to rest the elbow) as well as IV hand**
- Bracing probe hand against patient skin to anchor probe
- Hand/finger position on IV: **held towards, or at the back to assist with fine tip control**
- **Second provider assistance with triceps tension** (if mobile tissue or suspected patient movement).

Short-axis (Transverse) probe technique:

- Clean probe with disinfectant.
- Set up patient, equipment and provider to optimize success
- Hold probe in the non-dominant hand
- Place probe (with small amount of ultrasound gel on it) transversely across the area of interest.
- Ultrasound display & probe marker on the left side of the screen. (Left/right movements on display correspond to left/right movements of catheter).
- Examine the arm with the ultrasound, attempting to find the most suitable vein for IV access. Select vein choice based on best choice noted above
- Assess vein depth and presence of mobile tissue by lifting up on the probe. If mobile tissue consider using an assistant to support
- Once target vessel identified, center and enlarge it on the screen display.
- Compress the vessel with the probe to distinguish artery from vein. Two indictors are used to differentiate between a vein and an artery.
    1) Vein will collapse more readily than an artery.
    2) The artery will be pulsatile (compress vessel approx. ½ way to visualize best)
- Confirm vein depth and map vein course to ensure its appropriate for cannulation.
- Wipe away the gel from the area to cannulate
- Cleanse the skin area per standard procedure
- Place sterile cover on probe maintaining sterility of the tip.
- Apply sterile gel (or Chlorhexidine) just proximal to the cannulation area
- With the target vessel centered on ultrasound display, the point of catheter entry is in front of the probe in the middle. (to ensure that tip of the IV will not be placed too deep prior to coming into the view of the ultrasound screen)
- Hold catheter towards back in a pen like hold.
- Insert catheter at an angle depending on target vein depth (<30 for shallow veins and around 45 degrees for deeper veins >1cm)
- Once catheter under the skin, pause and adjust probe to visualize needle tip.
- As the catheter is advanced slide the probe incrementally away each time the tip of the catheter is visualized until the vessel is entered. (tenting of the vessel or ring sign is often seen prior to the catheter entering the vessel)
- Once the catheter tip is in the vessel **flatten the catheter angle to the skin and keep tracking the catheter tip up the vein approximately 1cm (or 4 to 5 movements) prior to separating the needle from the cannula.** Take care to not damage the posterior or lateral walls of the vein.
- **Confirm ultrasound guided catheter tip (See section below)**
- Procedures for securing the UGIVC, disposing of sharps, and drawing blood-work are performed in the same manner as for non-UGIVC.
- Document procedure and patient response in the patient care record.

NOTE: Short-axis technique compared to long-axis is easier for all providers with improved first pass success, quicker access, and decreased complication rates.[20]

Catheter gauge to Vessel diameter Ratio:

Larger diameter catheters and insufficient catheter-to-vein ratio can lead to a reduction of blood flow in the vessel and is associated with an increase of thrombosis and phlebitis rates.[22]

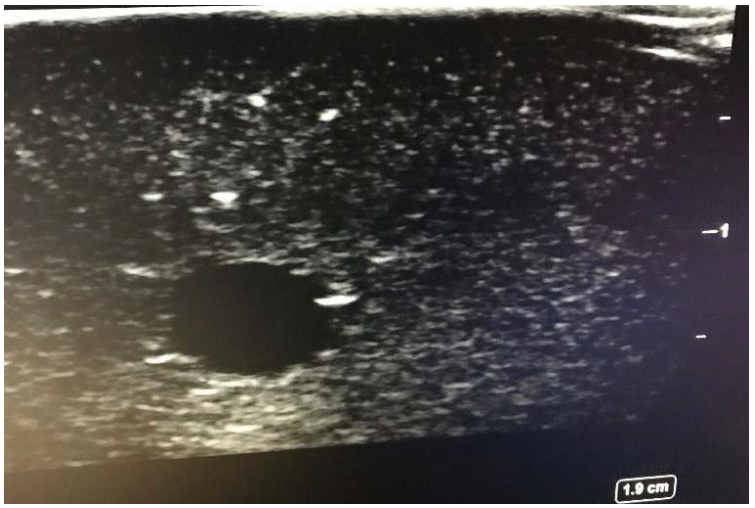
Ideally ensure a catheter-to-vessel ratio of less than 45%.[21] **Similar to traditional IV placement use the smallest gauge IV that is adequate for the intended use. (E.g. For an 18g IV select at least an internal vein diameter of 3mm)**

Confirmation of IV placement

Best practice is to confirm IV catheter placement. UGIVC have a higher reported failure rate than traditional IVs and can be harder to assess placement via traditional methods. Confirmatory steps should include assessing for catheter tip in the vessel as well as assessing approximate length of catheter in the vein as follows:

- Visualization of cannula within the lumen of the vein
  - on transverse orientation: 'bull's eye' or 'vanishing target' sign as the probe is slid away from the IV hub.
  - on longitudinal orientation: catheter seen lying within lumen (See pictures next page)

Target



Vanished target

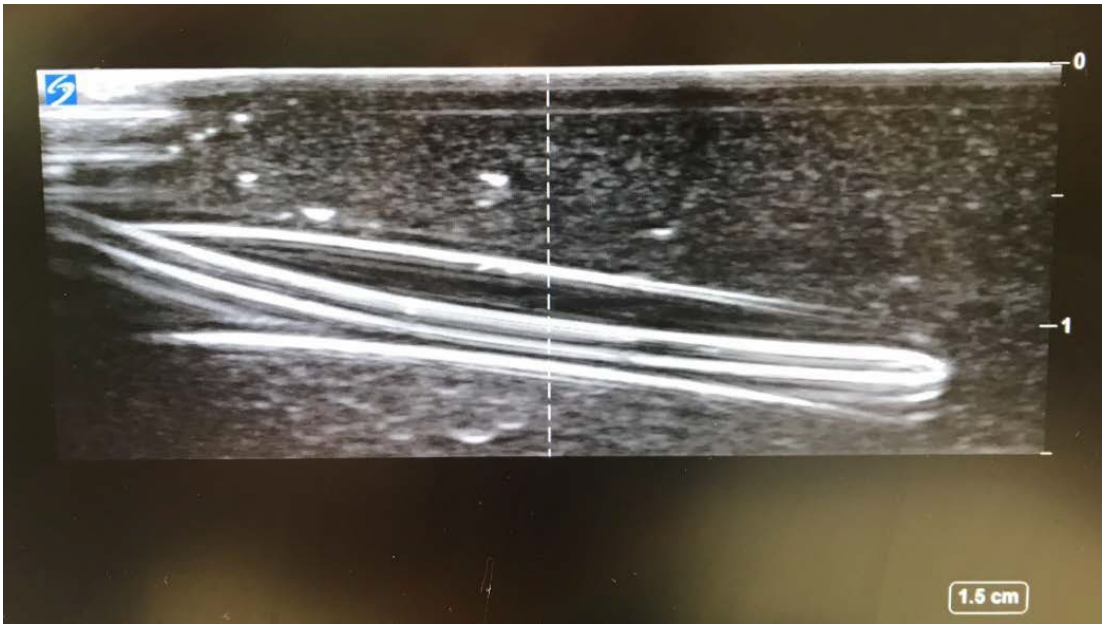
- Observing fluid flowing within the lumen of the vein (either via an NS flush or via ongoing IV fluid infusing). See link http://blog.5minsono.com/diva3/ for videos of how successful intra-lumen flush and interstitial IV flush appears on ultrasound. Can also been seen as "blinking" of the vessel when the IV flush is pulsed.

Confirming adequate catheter length in the vein

Adequate catheter length intra-lumen has been associated with catheter longevity. It is not required to physically measure the catheter length but visualization will provide an accurate assessment as demonstrated below.

See over for examples of inadequate and ideal catheter length in the vein.

Example of inadequate catheter length intra-lumen.



Example of ideal catheter length intra-lumen

If there is inadequate catheter length, consider the IVs planned use and whether it will be safe e.g. it might be adequate for blood draws and fluid resuscitation but inadequate for CT contrast or vesicant medication infusions. **If the site is used, careful taping so that traction is maintain proximally, as well as minimizing arm movement might prolong the IV. Consultation with the physician in these cases is recommended.**

Considerations and Safety Precautions

- **Extended time may be required to place an ultrasound-guided IV**
  - The time to place an UGIVC will decrease with experience and practice.
  - At one local site their initial experience of the length of time the nurse left their assignment to place an ultrasound guided IV was: Did not leave 14%, 0-5 minutes 6%; 6-10 minutes 35%, 11-20 minutes 35%; >20 minutes 9%

Best practice is if asked to place an IV outside of your clinical area please ensure the charge nurse or team lead is aware so the department priorities can be best managed.

- **Losing track of needle tip**
  - The needle is seen only as a small bright white ovoid structure, making it difficult to determine which part of the needle is being visualized.
  - Make small transducer adjustments up or down the vein to bring the needle tip into view. Maintaining visualization of the needle tip will reduce the chance of over-insertion and penetrating the posterior vessel wall.
  - Gently move the catheter from side to side to help re-identify the tip
  - Ensure that the gain is correctly set (dark enough) to highlight the catheter
  - Angle the probe away from provider to create a 90 degrees angle with the catheter to increase the brightness of the catheter
- **Not identifying surrounding structures**
  - Misidentifying an artery for a vein or not identifying a nerve bundle.
- **Not using a long IV catheter for deeper veins or a steep enough insertion angle**
  - If the IV catheter is too short, or if the catheter angle is too flat for deeper veins then there can be inadequate catheter intra-lumen risking displacement out of the vein and infiltration
- Applying too much pressure on the transducer will collapse the vein
- Delayed blood flash can occur with longer IV catheters – if you wait for blood flash to assess whether you are in the vein rather than keeping constant tract of the catheter tip you risk posterior vessel wall damage
- Poor / patchy images are often due to lack of gel. If adequate gel is used, ensure the gain and ultrasound preset mode (vascular) is correctly set to optimize the image on the screen display.

Additional general considerations

Immediate IV placement:

For patients that require immediate IV placement, ultrasound is not always the best option. So as not to delay care, consider placing a smaller IV and then use ultrasound to gain larger more appropriate longer-term access, or simply use traditional technique (e.g. landmark) to place an appropriate sized IV in an acceptable number of attempts. If the patient is a difficult start and appropriate IV access cannot be gained in reasonable number of attempts (e.g. greater than 4) inform the physician so they can decide upon the best access strategy to employ (e.g. further direct IV attempts, IO use, EJ, central line, or ultrasound guided).

Use in resuscitation

When a practitioner has gained sufficient procedural skill, ultrasound can play a role in resuscitations (not likely cardiac arrest where an IO is indicated); however, overall team/physician consideration should be given to the indications for an immediate IO or central line when indicated. Be aware that ultrasound use has been attempted when IO or central line was a better option and this should not occur. The time pressure of a resuscitation is not a good learning environment and can cause increase failure rate. Feedback from USGIV-trained nurses is that after approximately thirty to fifty successful starts, this technique has been successfully used to gain rapid access in resuscitations. Always ensure clear communication occurs with the team leader to ensure the right method is employed at the right time. (Note: using chlorohexidine can be helpful as it's easier to secure the IV post placement.)

Role of ultrasound-trained practitioners in mentoring new staff with traditional IV placement technique.

There is a concern with new staff not gaining expert traditional IV skills. To support new staff to become expert at traditional IV placement, when an ultrasound trained nurse is asked to place an ultrasound guided IV by that staff member, ensure that the patient has been assessed for suitable veins to cannulate via traditional technique and where appropriate support the junior staff in attempting these veins while ensuring best patient care.

Pediatric patient placement factors

There are many factors to consider when performing UGIV on pediatric patients making it more challenging and requiring more training and mentorship in comparison to adults. Due to the variety of ages and smaller vessel sizes, **RNs proficient in traditional pediatric IV techniques required approximately 20 ultrasound starts prior to feeling independent in the UGIV skill**. Prolonged mentorship wherever possible is preferred. Less mentorship time is required for providers who are already experienced with ultrasound on adult patients. For non-pediatric centers that have few pediatric IV start opportunities, if nurses skilled at adult placement are required to place a pediatric IV, consulting with the physician to assess the best access option should be considered.

To facilitate learning, ideally initial starts should be on the teenage population, then 5-12 year olds, followed by infants and lastly toddlers as quicker motor skills are essential for this last group. A location that is particularly useful to look is the forearm. This area can be braced during placement, and well secured afterwards. Tips and tricks that can be employed include:

- Using ultrasound to confirm location and presence of vein, then using traditional technique.
- When using small IV gauges on neonates, the pressure of advancing the IV collapses the vein. Use an 'advance then stop method' to allow for the vein to return to flow. Ensure feather light pressure of the probe on the skin; this prevents vein collapse.
- **Utilizing at least one or two other providers to stabilize the arm**. (see techniques below)
- **Develop a plan with the child and caregiver**. Wherever possible, including the child in the plan of care and adhering to it will provide the child situational assurance and control. This will lessen their anxiety. A few questions to ask: Do you want to look? Do you want me to count 1,2,3, poke? What game would you like to play on the iPad? Do you want to sit on mom or dad's lap?
- **Use local analgesic** (i.e. Maxilene®). Due to vasoconstrictive properties- suggest not to apply if vessel is <2mm. Some patients have a higher sensitivity; i.e. an initial 4 mm vessel can decrease to 1mm after a 20 minute application period of Maxilene®. https://extranet.ahsnet.ca/teams/policydocuments/1/clp-ahs-topical-anesthetic-hcs-265-01.pdf#search=maxilene
- **Provide oral sucrose** (i.e. Tootsweet®) for infants' 0-18months. https://insite.albertahealthservices.ca/Main/assets/Policy/clp-capital-childrens-general-comfort-sucrose-analgesia-pre-procedural-hcs-147.pdf#search=tootsweet%20stollery
- **Use all conventional distraction methods**. These include: sensory toys with lights and music, or an iPad with games or favorite videos. Remind them of positive coping mechanisms such as deep breathing and wiggling toes. Use positive language; such as "stay still" instead of "don't move."

- **Backwall prevention**:
  - Modify the angle of insertion, depending on depth of vessel. Pediatric population varies from 15-45 degrees.
  - Try to anticipate patient movement. Advance with a very light touch on the cannula and rest the cannula on a finger to prevent backwalling, this allows the cannula to move with patient movement.
  - If excessive patient movement while cannulating the vein: once in vessel, creep up for a few movements, then separate and advance (similar to traditional technique) rather than tracking the tip up the vessel a long way.
  - IV choice consideration is similar to adults regarding catheter length in vein. Longer 22g (1.75 in.) and 24g (1.25 in.) IVs are particularly useful for long term use.

- **Vertical skin movement:** Most prominent in patients less than two years of age and have more subcutaneous tissue. The holder stabilizes elbow while applying traction and upward pressure to limit tissue movement. Anchor vessel as required; adjust tension to maintain circular vein on US screen.

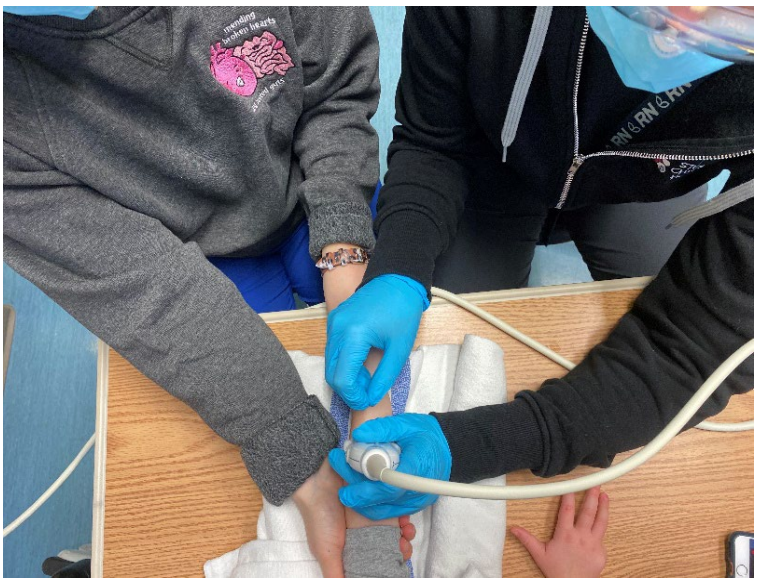
Pediatric patient positioning

- **Infants**
  - Swaddle the baby with desired limb out.
  - Accommodate need for negative angle (to reduce the risk of backwalling). Place a rolled receiving blanket beneath shoulder to support arm <u>OR</u> place baby near edge with arm off the bed. Holder secures elbow and extends wrist by holding hand. Have baby grasp holder`s 3rd and 4th digits, while index and thumb secure patient's wrist and thumb. Infant's natural reflex is to grasp.

- **Toddlers**
  - Hugging side hold with patient's legs secured between parents' legs. Reinforce with a blanket around parent's lap. Parent can also help secure shoulders with arm while holding a sensory distraction in other hand.
  - Holder braces elbow with fingers and extends wrist by holding patient hand. Have patient grasp holder`s 3rd and 4th digits, while index and thumb secure patient wrist and thumb.
  - Holder braces self on table or pillow. IV initiator braces on table or holder's arm.



- **School aged**
  - Place arm on table, with wrist extended over edge if accessing lower cephalic.
  - Place arm in "hot dog bun" blanket roll. This serves as a physical reminder for patient to keep arm still. The side of the blanket roll stabilizes the initiator's probe hand and wrist.
  - Follow patient specific plan for procedure and utilize conventional distraction techniques (as discussed above).

Additional online resources:

The additional optional videos cover anatomy refreshment and techniques for UGIVC placement (note Firefox might be required to view)

http://blog.5minsono.com/diva1/

http://blog.5minsono.com/diva2

http://blog.5minsono.com/diva3/

https://www.youtube.com/watch?v=d8VFgb9Edfw

https://docs.google.com/file/d/0B4rBvv7dCN7ZWmV4WVBtZ2Iya3c/edit?pli=1

References

1. AHS. Clinical Care Topics: Vascular Access Device Infusion Therapy: Adult & Pediatric – All Locations. Insite. https://insite.albertahealthservices.ca/tools/cgv/Page22202.aspx. Published 2018. Accessed June 4, 2019.
2. Fields JM, Piela NE, Au AK, Ku BS. Risk factors associated with difficult venous access in adult ED patients. *Am J Emerg Med*. 2014;32(10):1179-1182. doi:10.1016/j.ajem.2014.07.008.
3. Stolz LA, Stolz U, Howe C, Farrell IJ, Adhikari S. Ultrasound-Guided Peripheral Venous Access: A Meta-Analysis and Systematic Review. *J Vasc Access*. 2015;16(4):321-326. doi:10.5301/jva.5000346.
4. Feinsmith S, Huebinger R, Pitts M, Baran E, Haas S. Outcomes of a Simplified Ultrasound-Guided Intravenous Training Course for Emergency Nurses. *J Emerg Nurs*. 2018;44(2):169-175.e2. doi:10.1016/j.jen.2017.10.001.
5. Keyes LE, Frazee BW, Snoey ER, Simon BC, Christy D. Ultrasound-guided brachial and basilic vein cannulation in emergency department patients with difficult intravenous access. *Ann Emerg Med*. 1999;34(6):711-714. http://www.ncbi.nlm.nih.gov/pubmed/10577399. Accessed September 25, 2018.
6. Bahl A, Pandurangadu AV, Tucker J, Bagan M. A randomized controlled trial assessing the use of ultrasound for nurse-performed IV placement in difficult access ED patients. *Am J Emerg Med*. 2016;34(10):1950-1954. doi:10.1016/j.ajem.2016.06.098.
7. Kuo C-C, Wu C-Y, Feng I-J, Lee W-J. [Efficacy of Ultrasound-Guided Peripheral Intravenous Access: A Systematic Review and Meta-Analysis]. *Hu Li Za Zhi*. 2016;63(6):89-101. http://www.ncbi.nlm.nih.gov/pubmed/27900749. Accessed September 25, 2018.
8. Doniger SJ, Ishimine P, Fox JC, Kanegaye JT. Randomized Controlled Trial of Ultrasound-Guided Peripheral Intravenous Catheter Placement Versus Traditional Techniques in Difficult-Access Pediatric Patients. *Pediatr Emerg Care*. 2009;25(3):154-159. doi:10.1097/PEC.0b013e31819a8946.
9. Miles G, Salcedo A, Spear D. Implementation of a Successful Registered Nurse Peripheral Ultrasound-Guided Intravenous Catheter Program in an Emergency Department. *J Emerg Nurs*. 2012;38(4):353-356. doi:10.1016/j.jen.2011.02.011.
10. Shokoohi H, Boniface K, McCarthy M, et al. Ultrasound-guided peripheral intravenous access program is associated with a marked reduction in central venous catheter use in noncritically ill emergency department patients. *Ann Emerg Med*. 2013;61(2):198-203. doi:10.1016/j.annemergmed.2012.09.016.
11. Gottlieb M, Sundaram T, Holladay D, Nakitende D. Ultrasound-Guided Peripheral Intravenous Line Placement: A Narrative Review of Evidence-based Best Practices. *West J Emerg Med*. 2017;18(6):1047-1054. doi:10.5811/westjem.2017.7.34610.
12. Carter T, Conrad C, Wilson JL, Dogbey G. Ultrasound Guided Intravenous Access by Nursing versus Resident Staff in a Community Based Teaching Hospital: A “Noninferiority” Trial. *Emerg Med Int*. 2015;2015:1-4. doi:10.1155/2015/563139.
13. NENA-National UGIV Position Statement 2021. Retrieved June 14th 2022 from https://nena.ca/w/wp-content/uploads/2021/11/NENA-National-UGIV-Position-statement-28-Oct-2021.pdf
14. Melissa L. McCarthy, ScD*; Hamid Shokoohi, MD, MPH; Keith S. Boniface, MD, RDMS; Russell Eggelton, EMT-B E, Andrew Lowey, BS, EMT-P; Kelvin Lim, BS; Robert Shesser, MD; Ximin Li, MS; Scott L. Zeger P. Ultrasonography Versus Landmark for Peripheral Intravenous. *Ann Emerg Med*. 2016;Volume 68(no 1).

15. Vinograd AM, Chen AE, Woodford AL, et al. Ultrasonographic Guidance to Improve First-Attempt Success in Children With Predicted Difficult Intravenous Access in the Emergency Department: A Randomized Controlled Trial. *Ann Emerg Med*. 2019;74(1):19-27. doi:10.1016/j.annemergmed.2019.02.019.
16. Riker MW, Kennedy C, Winfrey BS, Yen K, Dowd MD. Validation and Refinement of the Difficult Intravenous Access Score: A Clinical Prediction Rule for Identifying Children With Difficult Intravenous Access. *Acad Emerg Med*. 2011;18(11):1129-1134. doi:10.1111/j.1553-2712.2011.01205.x.
17. van Loon F, van Hooff L, de Boer H, et al. The Modified A-DIVA Scale as a Predictive Tool for Prospective Identification of Adult Patients at Risk of a Difficult Intravenous Access: A Multicenter Validation Study. *J Clin Med*. 2019;8(2):144. doi:10.3390/jcm8020144.
18. Rupp JD, Ferre RM, Boyd JS, et al. Extravasation Risk Using Ultrasound-guided Peripheral Intravenous Catheters for Computed Tomography Contrast Administration. Jang TB, ed. *Acad Emerg Med*. 2016;23(8):918-921. doi:10.1111/acem.13000.
19. Pandurangadu AV, Tucker J, Brackney AR, Bahl A. Ultrasound-guided intravenous catheter survival impacted by amount of catheter residing in the vein. *Emerg Med J*. 2018;35(9):550-555. doi:10.1136/emermed-2017-206803.
20. Vezzani A, Manca T, Brusasco C, et al. A randomized clinical trial of ultrasound-guided infra-clavicular cannulation of the subclavian vein in cardiac surgical patients: short-axis versus long-axis approach. *Intensive Care Med*. 2017;43(11):1594-1601. doi:10.1007/s00134-017-4756-6.
21. Gorski, L. A. , Hadaway, L. , Hagle, M. E. , Broadhurst, D. , Clare, S. , Kleidon, T. , Meyer, B. M. , Nickel, B. , Rowley, S. , Sharpe, E. & Alexander, M. (2021). Infusion Therapy Standards of Practice, 8th Edition. *Journal of Infusion Nursing,* 44(1S), S1–S224. doi: 10.1097/NAN.0000000000000396.
22. Paterson, R.S., Chopra, V., Brown, E.,et al. (2020). Selection and Insertion of Vascular Access Devices in Pediatrics: A Systematic Review. *Pediatrics.* Jun 2020, 145 (Supplement 3) S243-S268; DOI: 10.1542/peds.2019-3474H

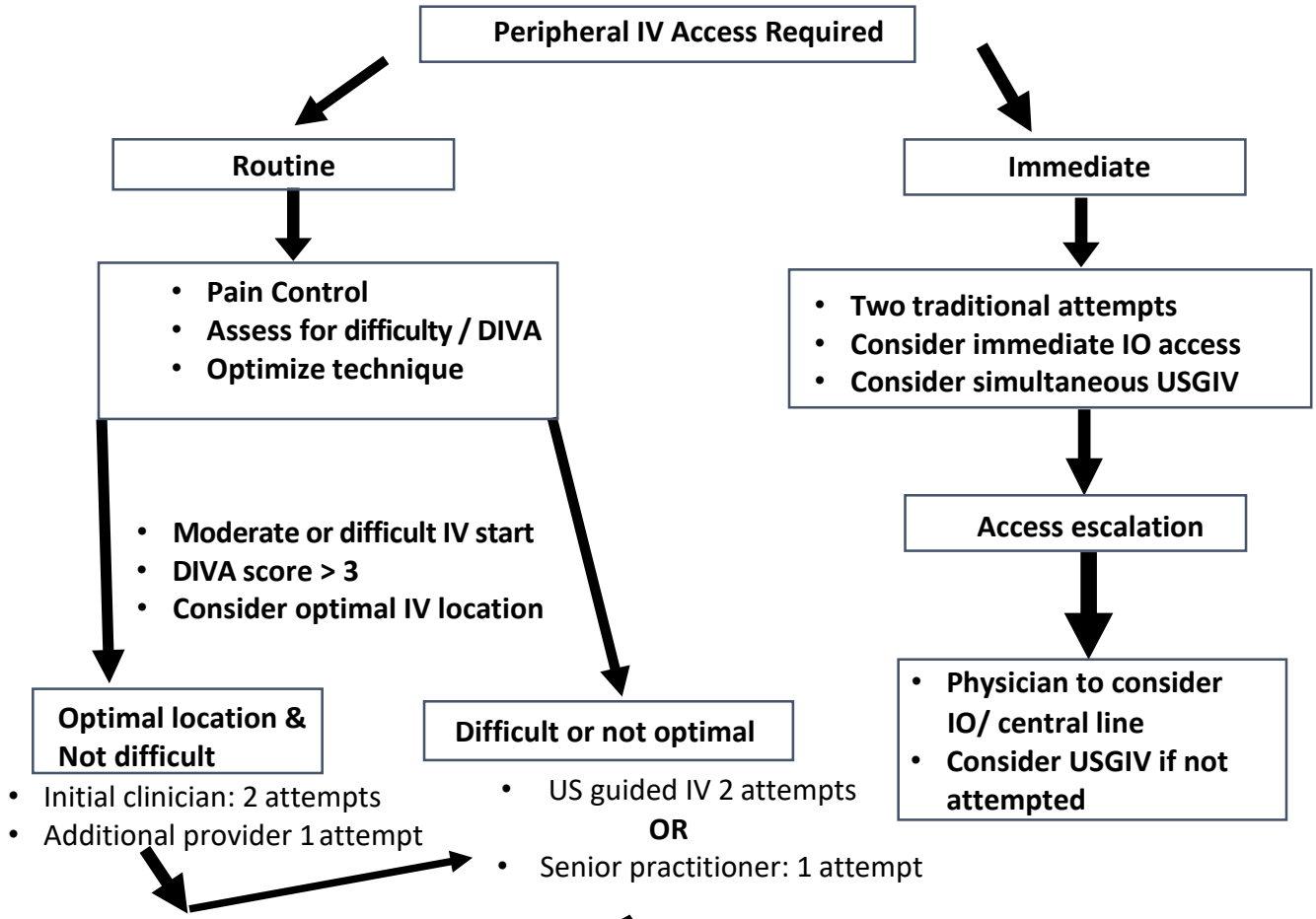
Procedural performance criteria checklist

Name:
1. Gathers equipment, introduces self, identifies patient and need for UGIVC, and takes universal precautions
2. Identifies indications for using ultrasound for IV catheter placement
3. Uses an approved antiseptic to clean the probe (before and after procedure)
4. Utilizes tourniquet or blood pressure cuff on venipuncture mode as required
5. Adjust gain and depth of ultrasound view as appropriate
6. Optimizes patient, provider, and equipment throughout (inc. protects probe)
7. Identifies best vein for cannulation and best length and gauge of IV to use a) Confirms vein rather than artery by compression and no pulsatile movement b) Confirms vein depth and appropriate catheter selected (gauge and length) c) Confirms vein course is sufficiently linear to insert the IV catheter.
8. Wipe away gel. Cleanse site per standard procedure
9. Place a sterile cover on probe ensuring sterility of surface that will touch the skin and apply the minimal required sterile gel to the outside of the sterile cover
10. In short access (transverse) orientation, Map vessel direction, center vessel in middle of screen
11. Insert catheter at approximately 30 degree angle in-line with center probe marker and direction of vein
12 Identify and tracks needle tip into the vein by sliding the probe to keep IV tip in view (dynamic tip tracking)
13. Track needle tip intra-lumen for appropriate length prior to separating and advancing catheter
14. Secure IV catheter per routine traditional practice
15. Confirm adequate catheter in vein including with a visualized intra-lumen saline flush
24. Completes remaining procedure per traditional practice (inc. documentation)

Record of mentored starts

#	Date	Success?	Facilitator (Print/sign):	#	Date	Success?	Facilitator (Print/sign):
1				9			
2				10			
3				11			
4				12			
5				13			
6				14			
7				15			
8				16			

Appendix A: Suggested ED clinical pathway for vascular access:
Aim: IV access (right gauge/right location) with minimal attempts



USGIV

- Consider senior USGIV practitioner
- Consider additional USGIV attempts
- **Notify physician**
- Discuss and document plan

(could include additional IV attempts)

Optimize technique

- Warming (safe wet temp warmth)
- Assess all possible sites
- Use assistant(s) to ergonomically stabilize joint/limb/body
- Consider vein viewer

DIVA Scoring Tool

Predictor	0 Points	1 Point	2 Points
Visible vein	Visible	-	Not Visible
Palpable vein	Palpable	-	Not palpable
Age	≥3 years	1-3 years	<1 year

PAIN CONTROL

All patients (Except Immediate IV)
Pediatric considerations:
Distraction/Child Life
Sucrose
Topical Local anesthetic

Appendix B: Tips for the creation of a successful USGIVC program (Not required to review for learners: resource for program organizers)

1. Educational continuity - Ensure educational supports are readily available
2. Ensure easy access to ultrasound machine
3. Lead instructor/mentor ideally should have 50 or more starts to appreciate challengers that learners may have during education sessions (simultaneous learning not effective)
4. Instructor must develop intricate knowledge and troubleshooting abilities with the U/S machine
5. To ensure provider success with UGIVC select staff who will provide good coverage on the floor. (Fulltime/Days/Nights)
6. Increasing early opportunities for staff to perform UGIVC is key for success
7. Develop a selection process to ensure equal teaching opportunity within the set selection criteria
8. Teaching gel models and correct catheter sizes available
9. Validate the purpose of teaching USGIVC
10. Learning package and then hands on learning sessions very important
11. It is common for staff to need more than 10 mentored starts to gain comfort and making these readily available is key to success with these staff
12. Select smaller groups to perform skill which allows them more opportunity to perform learned skill
13. Select smaller groups and longer intervals. (i.e. quarterly; Group 1 – 3-4 staff; Group 2 - 3-4 scheduled 2, 3 months later)
14. Feedback form for end user to provide information to the lead instructor about each UGIVC placed. (Ensuring compliance to program-who is getting their competency skills)
15. Highlighting the importance of protecting the probe and ultrasound device to ensure longevity:
    a. Probe cleaning process
    b. Fragility of the probe and monitor
16. For any questions please reach out to Domhnall.odochartaigh@ahs.ca